In 10 of the 55 cases the fluid was bloody; in 2 others it was purulent.

In Table IV the relation of ascites to the different varieties of ovarian tumor is demonstrated. All these cases were operated on. I think many persons will be surprised, as I was, to learn how frequent is the association of ascites with benign ovarian growths such as fibroma and multilocular cyst. I have no idea why a small ovarian fibroma without metastases should produce extensive ascites so frequently.

Why should a small percentage (7.9 per cent.) of cystic tumors produce ascites? One would expect to find it in all cases or in none.

SUMMARY AND CONCLUSIONS.

1. Among the possible causes of extensive ascites we must not lose sight of the small solid tumors of the ovary.
2. Pleural effusion may be produced by an extensive ascitic accumulation. This association may lead to a false diagnosis of pleural and peritoneal tuberculosis.
3. The cure of both pleural and peritoneal effusions may result from excising a benign ovarian tumor.
4. Among all causes of ascites, tuberculous peritonitis may sometimes be recognized by the greater slowness of its accumulation of fluid.
5. Intestinal obstruction ranks fifth and disease of the female genitals sixth among the causes of ascites, being surpassed only by cardiac disease, nephritis, cirrhosis, and tuberculous peritonitis.
6. Besides the causes just mentioned, abdominal neoplasms and adherent pericardium are the only factors of importance in the production of ascites.

INFANTILE HYPERTROPHIC STENOSIS OF THE PYLORUS, BASED UPON A PERSONAL EXPERIENCE OF SEVEN OPERATED CASES.

By Frank E. Bunts, M.D.,

PROFESSOR OF PRINCIPLES OF SURGERY AND CLINICAL SURGERY, WESTERN RESERVE UNIVERSITY; VISITING SURGEON TO THE ST. VINCENT'S CHARITY HOSPITAL; CONSULTING SURGEON TO THE CLEVELAND CITY HOSPITAL, CLEVELAND.

From the first publication of a case of infantile pyloric stenosis by an American physician, Hezekiah Beardsley, in 1778, to the time of the publication of the Danish physician Hirschsprung's 2 cases, in 1887, little or no attention had been given to this important and somewhat frequent malady of infancy, but with each succeeding year reports of cases are now multiplying, till what was once considered a rare disease is now coming to be recognized as of frequent occurrence, and our profession generally is growing fairly well acquainted with the clinical phenomena connected with it.

Evidently, however, it is either not recognized as frequently as it should be, or a decided feeling against operation must exist, since in a city the size of Cleveland but 9 cases, so far as I am aware, have been operated upon during the last five years. It is almost useless to go into the statistical results of operations for infantile stenosis of the pylorus, since, notwithstanding the increasing number of operated cases, the average mortality remains in the neighborhood of 50 per cent. It is to be noted, however, that in the hands of those whose number of cases is large, the mortality is decreasing slightly, and this may be ascribed to two causes—first, though not in my estimation the more important, because of increasing familiarity with the details of the operation and improved technique; and second, and of great importance if true, because physicians have had their attention called to the matter until they are quicker to recognize the symptoms and to urge operation, so that occasionally an infant is brought for operation that is not nearly moribund at the time. The laity must always be an obstacle to early operation, for marasmus is a well-known condition, and the feeling that a proper diet will correct the trouble will often prevent their consenting to an interference early enough to be of any avail.

Because of these considerations, it seems to me that it is proper to present some of the facts pertaining to this interesting and important infantile anomaly. My observations rest upon a study of 7 cases operated upon by myself, of which 4 lived and 3 died.

First, as to the pathological anatomy. It might seem that the stomach would be greatly dilated as a result of the pyloric obstruction, and while such cases have been reported, it is not uniformly so. In none of my 7 cases was there extreme dilatation. Some cases have, on the other hand, been reported in which the stomach was contracted to approximately one-half of the normal size. It is conceivable that this is due to the persistent and easy vomiting which does not permit of the stomach becoming habitually overdistended, and it may be that the greatly exaggerated musculature of the pylorus, by its almost complete obstruction, causes the much weaker cardia to give way and allow of easy regurgitant vomiting.

The pylorus itself is enlarged for a distance of nearly an inch, is pale and glistening in appearance, and has the consistency and feels on palpation much like the cervix uteri; so hard, indeed, that it is often compared to a piece of cartilage. Macroscopically, on cross-section, there is an exaggerated muscularis with a mucosa thrown into folds which in some cases completely block egress from the stomach into the duodenum. Microscopically, as shown in the accompanying drawings (Figs. 1 and 2), a cross-section of the pylorus shows the following changes: (1) Almost complete

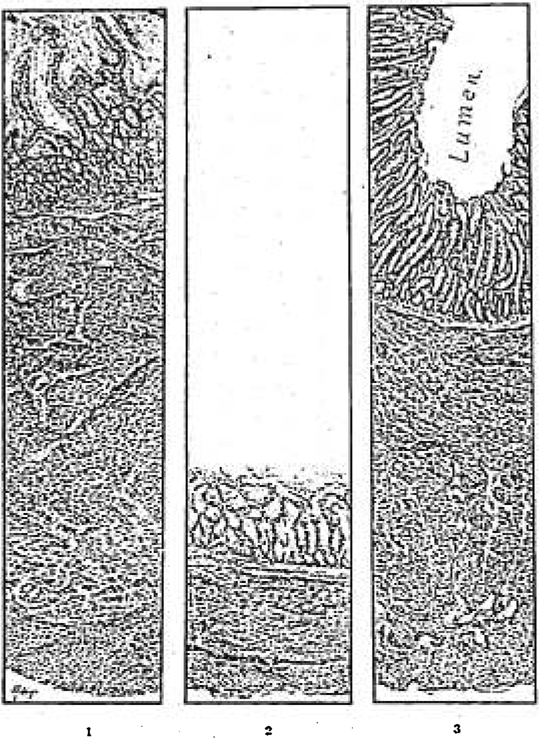

Fig. 1.—Microscopic sections of pylorus: 1, pyloric stenosis with no lumen; 2, normal pylorus: 3, pyloric stenosis in infancy with a lumen.

obliteration of the lumen, so that only a pin-point aperture exists. (2) The mucosa and submucosa are thrown into four folds by the contraction of the underlying muscle, and this seems to be the cause of the obliteration of the lumen. (3) There is a great thickening of the circular muscle layer, and some fibrosis. (4) The other layers do not seem to be greatly changed, although some slight increase in the size of the longitudinal band of muscle is also to be noted, and a slight catarrhal inflammation of the mucosa. The muscular bundles in the submucosa do not appear to be increased.

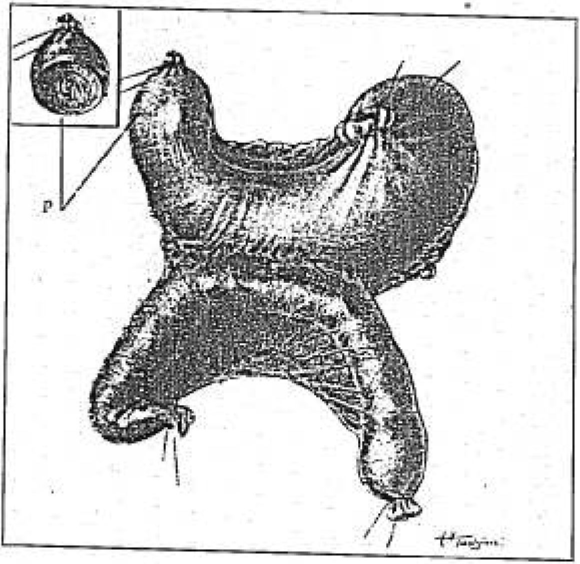

Fig. 2.—Pyloric stenosis in infancy with complete occlusion (*p*). This specimen was obtained from a patient on whom a gastro-enterostomy had been performed.

While the enlargement of the pylorus may, in its appearance and consistency, resemble a tumor, it is, as has been conclusively shown in numerous specimens, purely an hypertrophy, though in a rare case reported by Dent an aberrant portion of pancreas was found situated beneath the pyloric mucosa, and Torkel found situated beneath the submucosa an abnormal glandular structure which he considered to belong to a wandering Brunner's gland. Important contribution to our knowledge of the pathology of this condition has been made by Ibrahim and others by the examination of the stomachs of infants who had recovered under medical treatment from what had been clinically diagnosticated as pyloric stenosis, and died from other accidental causes. In these it was shown that the pyloric hypertrophy still remained, but that there had been developed a compensating hypertrophy of the stomach walls.

This observation has led Fredet and Guillemot to believe that in hypertrophic stenosis the organic lesion is not all, and that we must give a large place to secondary factors such as spasm, and to tumefaction of the mucous folds. On this basis it is easy to comprehend why and how the hypertrophic stenosis might not manifest itself until long after birth, and to answer the most serious objections to the theory of the malformation being of congenital origin. They also think that this explanation does away with the claim that hypertrophic stenosis cannot be cured by purely medical treatment, and that such reported cases of cure do not belong to the class of cases described by Hirschsprung.

While the evidence at hand at present is not sufficient to prove definitely that a true infantile as distinguished from a congenital hypertrophy of the pylorus does not exist, yet it seems probable that the latter hypothesis may well explain all the phenomena present.

The symptoms are of the greatest importance, for it is only by their early recognition and interpretation that we may expect to secure operative interference at a time when we may expect to lower materially the percentage of mortality. I believe that operative procedures have established their value as a life-saving measure. It remains now to secure the coöperation of the physicians and the laity in securing the operation at an early and favorable time. Naturally, the first symptom to attract attention is vomiting. This may not make its appearance for several weeks after birth or may begin with the first nursing. It seems to matter but little whether the child is breast fed or bottle fed, the cause is equally operative. At first the vomited matter represents but part of the ingested material, but eventually, notwithstanding every art of infant feeding, every mouthful of food is apparently ejected. Sometimes there will be a few hours or a day when the retention of a portion of the feeding will bring false hopes of recovery, to be followed, however, by the same distressing symptoms. In such cases we may imagine that the mucous folds of the pyloric outlet have become a little less congested, the opening a little less constricted, thus allowing a temporary escape of fluids. With the persistent vomiting we have a progressive emaciation of the infant, so that a child weighing eight or ten pounds at birth may weigh not over five or six pounds when it comes to operation some six weeks later.

If we can rule out the possibility of the vomiting being purely reflex from some other disease, it becomes of very great diagnostic importance. The absence or a small number of bowel movements soon becomes a marked symptom, and gradually the development of anuria is noted.

A symptom of the greatest importance, but one likely to be overlooked while the baby is fat and plump, is the dilatation of the stomach followed by a marked wave of contraction plainly visible as it travels toward the pylorus. In the greatly emaciated and delayed cases this phenomenon is peculiarly well marked, and may be watched as it arises spontaneously or may be brought into action by sharp palpation over the stomach. This ball-like tumor, with its peristalic wave is so marked as to be readily made out by the nurse or mother.

It might be thought that the pyloric tumor would be readily palpable, but from my own experience such was not the case, for in only 2 out of 7 was I able positively to identify it. So that while its presence must be considered of the greatest significance, its absence in the presence of other confirmatory symptoms, is not to be seriously considered as evidence against the stenosis being present.

In their order, then, of importance, ruling out reflex disturbances, I would place the symptoms as: (1) Persistent vomiting, (2) emaciation, (3) visible dilatation of stomach, (4) visible peristalsis of stomach, (5) diminution and absence of stools, (6) anuria, (7) presence of palpable tumor of pylorus.

Colored powders incorporated in the food and absent from the stools might help in the diagnosis of pyloric obstruction, but I have not had an opportunity to make use of this method. In deciding for an operation one must take into consideration that the relatively early appearance of the symptoms mentioned speaks for organic rather than spasmodic stricture, and also that the latter condition should speedily respond to proper medical treatment.

The percentage of recoveries after operation has not been particularly gratifying (from 50 to 60 per cent.), if we consider it from the standpoint of percentage alone, but if we consider that these cases when they come to the surgeon have almost uniformly received long continued and varied medical care, and have reached the stage where it seems almost incredible that any of them should recover from gastro-enterostomy, then the percentage of recoveries does not seem unfavorable. They are emaciated, starving, and dying of thirst, and yet not only a severe operation must be gone through, but the extremely difficult problem of nourishment in the face of all these obstacles must be solved and solved quickly to save the infant.

The prognosis will improve as earlier diagnosis is made and earlier consent of parents to operation obtained. It would, I believe, be highly desirable to have a surgeon see suspected cases in consultation with the physician, not with a view to immediate operation, but in order better to arrive at an harmonious conclusion as to the safe and imperative time for surgical intervention. That even under the unfavorable existing obstacles to early operation improvement in the last three years has taken place, is shown by the results in 38 such cases collected by Fredet and Guillemot, in which the mortality was but 26.31 per cent.

In my own series of 7 cases, 4 have recovered and are still living. In only 1 of these was the patient what might have been termed a fair operative risk. In only 1 of the 3 cases that died did I succeed in getting an autopsy. This was in an extremely feeble and emaciated child in which we had detected mesenteric tubercles at the time of operation. The child lived forty-eight hours, and died without any rise in temperature or other disturbances, probably from sheer exhaustion.

The drawings herewith presented are taken from this case and also from an apparently normal pylorus in a child ten days old dying from esophageal obstruction. One of the other deaths might possibly have been due to too severe crushing of the stomach or intestine with clamps (used in the first 2 operations) though of this I cannot, of course, be perfectly certain. The other lived eighteen hours, and died very suddenly after a convulsion and sharp rise in temperature.

My own conviction is that with even reasonably promising cases the mortality should be in the neighborhood of 25 per cent. but I do not believe that this reduction in mortality will be due very largely to an improved technique, but rather to securing patients at an earlier and more favorable time.

Regarding the technique, ether has been used in each case. It has been sought to retain the body heat by cotton wadding bandaged about the limbs and by warm water bags under the operating table pads. The incision has been slightly to the left of the median line, and has extended down to or below the navel, in one case enabling me to relieve an epigastric hernia at the same time. In some of the cases the stomach was previously washed out, but even then I found the stomach tensely distended with gas and a considerable amount of curds poured out when the stomach was opened. This distention of the stomach is quite annoying until the stomach has been opened.

Notwithstanding certain theoretical advantages in the posterior anastomosis, I have done the anterior operation in all the cases, making a long loop, but not doing an additional anastomosis between the two limbs of the jejunum. My reason for adhering to the anterior operation in these cases has been a fancied lessening of the shock due to the lessened exposure of the abdominal viscera, and to the somewhat increased ease of operation when the stomach is dilated and tense. Personally, while I now habitually perform the posterior no-loop gastro-enterostomy in adult patients, I have never been convinced that the results were in any way superior to those obtained by the anterior method, so that if the anterior operation offers any advantage either in facility or safety, it seems to me proper to make use of it.

The closure of the abdominal wound is of considerable importance, for in a number of reported cases the line of incision has given way under the severe and uncontrollable straining of a crying infant, and the intestines protruded through the opening. In hope of preventing this I have used the chromic catgut sutures for both muscles and peritoneum, and reënforced these by silkworm-gut sutures through the entire thickness of the abdominal wall, removing part of them at the end of eight days and the remainder in ten to twelve days.

Feeding the child is of the very greatest importance, and I am much indebted to the physicians who have been associated with me in these cases for the valuable suggestions which have enabled me to formulate a general plan of attempt at nourishment that has proved fairly satisfactory. Sterilized water may be given, a teaspoonful at a time, as soon as the effects of the ether have passed off, and on the following day albumin water may be given in small amounts frequently repeated. For the first three days, however, most reliance must be placed upon rectal feeding, peptonized milk being used for this purpose at four-hour intervals. Whenever the mother's milk can be obtained, it should be used for this purpose. At the end of two to three days the stomach will be sufficiently quieted to permit of the addition of whey, and then mother's milk or modified milk in small quantities to the albumin water; and in exceptionally favorable cases the babe can be put to the breast to nurse for short periods.

No fear of leakage along the line of sutures need be felt if the operation has been thoroughly performed and the amount of nourishment given at any one time is small in quantity. The food is gradually increased as the condition of the child demands it, and the whole body rubbed with sweet oil from time to time to aid, however slightly, in the nourishment of the infant.

Dr. Scudder has made an elaborate and valuable study of the conditions following recovery, especially as to the metabolic changes, and, in a general way, these infants seem to do as well as others of the same age. The earliest of my own cases is now over four years old, and is as strong and hearty as any child could be expected to be. My third case is nearly three years old, and in perfect health. The fifth is one year old, and in excellent health. While the seventh and last is but seven weeks old, it has passed through the crisis of operation and feeding, and is gaining at the rate of about two ounces per day.

In concluding these fragmentary observations I beg again to call attention to the symptoms of the pyloric obstruction, and to the great importance of its early recognition, and appreciation that surgery offers a really brilliant prospect for its relief in properly selected cases.